Inventor: PERKINS, John Patrick
Serial No.: 10/722,494
Filing Date: 11/28/2003
Examiner: Kishor Mayekar
Group Art Unit: 1753

REMARKS

The Office action of June 25, 2007 has been carefully considered and the application is amended accordingly.

Claims 8-27 are present in the application.

The Examiner's objections set out in paragraph 3 with respect to claims 1, 5, 7 and 8 are not applicable. Claims 1, 5 and 7 are not present in this continuation application, and the spelling in claim 8 is in accord with U.S. standard spelling. The typo in claim 16 has been corrected.

In paragraph 5 of the Office action, claims 8-10, 12-18 and 20-24 are rejected under 35 U.S.C. 103(a) as being unpatentable over Carlin in view of Dion *et al*. And Sachs. The Examiner is correct to suggest that US 2,578,505 (Carlin) is of some similarity to the present invention. Carlin suggests treating fluid flowing in a pipe by attaching ultrasonic transducers 11 in intimate contact with the wall of the pipe 10 (col. 2. Lines 18-24) and to ensure that all parts of the fluid are treated, he suggests that there may be several rings 11 and 11' of electroacoustic crystals longitudinally spaced out along the pipe (col. 2, lines 46-51.) He also teaches that to insure (sic) the maximum amount of energy generated by the crystals passes through the wall of pipe 10, the material of the pipe should have the same value of (density x velocity) as that of the crystal (col. 3 lines 2-8).

However, Carlin does not teach or suggest any particular value for the ultrasound intensity, nor does he teach or suggest any value for the ultrasonic energy density. Further, no information is given about the size of the pipe, nor does he provide specific

teaching about the proximity of the transducers and clearly does not teach or suggest that the power dissipation is at least 25 W/liter but no more than 150 W/liter specifically recited in independent claims 8, 16 and 24.

The secondary citation, US 4,375,991 (Sachs), is concerned with cleaning processes to remove biofouling from heat exchangers and the like by providing a planar transducer array (Abstract, lines 4-8) and, in this very different context, specifies that the desired power intensity radiated from the apparatus would be between 0.5 and 2 W/cm^2 to ensure cavitation (column 11, lines 15-18.) However, Sachs then suggests that the transducers might be pulsed at ten times their normal power level (column 11 lines 59-67). That would suggest operating at an intensity up to 20 W/cm^2, which is well above the limit of "no more than $3W/cm^2$" specified in Applicant's claims (to ensure that cavitation blocking does not occur.)

Thus, Sachs would seem to provide no suggestions for appropriate values of power density, as the ultrasound is radiated into an essentially unbounded region, so the volume subjected to ultrasound is indeterminate (see for example FIG. 5). So combining the teaching of Carlin with the teaching of Sachs would not teach or suggest the present invention, as neither document suggests any information about power density, let alone the specific numerical values set out in Applicant's claims. That is to say, neither document gives any teaching as to how close the transducers should be arranged to each other, and as to how many transducers in total should be arranged in the array.

The Examiner has suggested that the selection of container diameter would be obvious to one having ordinary skill in the art;

perhaps, but there are additional parameters to be considered. As regards the selection of the proximity of the transducers and the number of transducers to achieve a particular numerical value of power density, the Examiner has suggested that "proper adjustment of a known effective variable" is within the capabilities of one with ordinary skill. However, this does not apply in the present context, as the power density has not been recognized by the prior art as a variable of any significance. Neither Carlin nor Sachs suggests any particular numerical value of power density, so it can hardly be obvious to adjust the proximity and number of the transducers to attain a power density between 25 and 150 W/liter.

The Examiner has also suggested that US 6,361,747 (Dion et al) is relevant, in that the features of claims 12-15 and 20-23 are taught by Dion *et al.* column 4. However, these claims are clearly distinguished in that, as specified in claims 8 and 16, the transducers are attached to the wall as an array extending both circumferentially and longitudinally. In contrast, in Dion *et al.* there is a single ring of long, rectangular prismatic transducer bars each with a narrow head that is pressed onto the flexible tube.

More specifically, Dion *et al.* does indeed suggest energizing groups of transducers differently, but his suggestion is to arrange that the phase varies from one transducer to another, which requires that the transducers are at the same frequency - there is no suggestion that the frequency should differ from one transducer to another, as required by claims 14, 15, 22 and 23.

In paragraph 6, the Examiner has asserted that claims (apart from 11 and 19) are obvious in the light of Dion combined with Sachs. However, these claims are clearly distinguished in that, as

specified in claims 8 and 16, the transducers are attached to the wall as an array extending both circumferentially and longitudinally. In contrast in Dion *et al*, there is a single ring of long, rectangular prismatic transducer bars, each with a narrow head that is pressed on to the flexible tube. The head of each bar is coupled by lubricant to the tube.

It is not clear how the combination of Dion with Sachs could lead to the present invention, as in neither of these citations are there transducers attached to a wall of a tube. In Dion there is no information about power intensity at the surface, although the use of the transducer bars is clearly intended to maximize the intensity at the surface, as the bars are intended to amplify the sound intensity (e.g. the column 4 lines 54-60).

If one of ordinary skill in the art starts with the design of Dion, and then introduces the power intensity as specified by Sachs, the result ends up with a circular ring of amplifying bars pressing against the outside of a flexible tube and coupled to it by lubricant, producing a power level between 0.5 and 2 W/cm^2 (unless you take up the suggestion of operating in a pulsed mode up to 20 W/cm^2). This is clearly different from the present invention, as it does not provide transducers in an array extending both circumferentially and longitudinally, the transducers being attached to a wall; still less does the proposed combination provide any suggestion of selecting the proximity and number of transducers to attain a power density between 25 and 150 W/liter.

As regards the Examiner's emphasis that "proper adjustment of a known effective variable" is within the capabilities of one skilled in the art, applicant respectfully points out that the power density is not suggested as a "known effective variable," so

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it can hardly be obvious to adjust parameters to attain a power density between 25 and 150 W/liter.

In paragraph 7 the Examiner has asserted that claims 11 and 19 are obvious as argued above, further in view of Desborough *et al.*, US 5,658,534. This citation does indeed suggest use of a buffer liquid between the end of a transducer cone and a pipe wall, which has some similarities to the additional feature of claims 11 and 19; however, in the present invention, it will be appreciated that the buffer liquid lies between two concentric tubes, whereas in this citation there is only a single tube. And in this citation the transmitted power, over a circle of diameter 50 mm, is about 100 W (column 3 line 29 and column 4 line 2), which is more than 5 W/cm^2, and so well above the limits required by the present claims.

In Paragraph 8, the Examiner has drawn attention to US 5,484,573 (Berger et al). This patent describes a reactor with a number of transducers integrated into the vessel wall so the face of the transducer is exposed to the liquid; transducers are mounted as a single circular ring in the side wall, and also in the base. No information is provided about power intensity or about power density. The benefit is apparently that when processing small quantities of material, only the bottom transducers need be used, while for a larger volume, the side transducers may be switched on also (column 2 lines 21-33). This neither teaches nor suggests the features of the present invention.

In view of the foregoing explanations setting forth the differences between applicant's claimed invention and the proposed combinations of prior art, reconsideration of the application is requested and allowance of claims 8-27 is courteously solicited.

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The Commissioner is hereby authorized to charge any required fees associated with this communication and during the pendency of the application under 37 CFR 1.16 and 37 CFR 1.17 or to credit any overpayment to Deposit Account No. 082670.

Respectfully submitted,

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Date

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I hereby certify that this correspondence is being transmitted by facsimile this day to Examiner Mayekar at the United States Patent and Trademark Office, Art Unit 1753, to fax No. 571-273-8300.

September 25, 2007

Date Signature